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Dental Evidence in Forensic Identification: Critical Analysis

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ABSTRACT

Forensic dentistry is a vital part of forensic science which has many therapeutic aspects as a result of which it becomes extremely important. Bite mark analysis is one of the several aspects of forensic odontology, bite marks are a pattern that is produced by dentition of humans and animals and other associated structure that is capable of being marked. Bite mark analysis is very essential in the criminal justice system as it is present in many violent crimes like sexual assault, homicide, child abuse or attempted suicide. These marks are valuable in the determination of the age of the criminal and the type of physical abuse that has taken place.

The review would highlight the importance of bite mark analysis as forensic evidence. The paper would emphasize the admissibility issues that are faced by bite mark evidence. The reasons behind the unreliability of bite mark analysis as forensic evidence for legal purposes would then be studied. Many research studies and surveys would be quoted for supporting its uncertainty as evidence. Bite marks as forensic evidence in an Indian perspective would be looked upon to understand the shortcomings that specifically Indian criminal legal system faces in the enforcement of bite mark as evidence. And then the paper would include some suggestions and conclusion which could improve the evidentiary value of the bite marks analysis

Keywords: *Bite Mark, Criminal Legal System, Evidence, Forensic Science, Forensic Odontology.*

I. INTRODUCTION

In recent times, trends show that crime has become very sophisticated and for dealing with them, the branch of science which has improved methods and procedures for solving such criminal cases is needed. Forensic Science is one such branch that uses science and technology for the investigation, detection of crime and operation of justice.³ One of the parts

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³ Prabhav Kumar Iyer & Archana Santhanam, *Awareness of Forensic Odontology among Legal Professionals: An Institutional Study*, 20(2) MEDICO-LEGAL UPDATE, 141-147 (2020).

of forensic science is “Forensic Odontology.” **Keiser- Nielson** has explained the term forensic odontology as the branch of forensic medicine that deals with the official handling, investigation and presentation of dental evidence in light of the administration of justice.⁴

The primary utility of dental odontology is in the examination and identification of human remains, based on individualistic characteristics that are found in the teeth of every person. Teeth are one of the strongest parts of the body that not only withstand any sort of explosion but also remain intact without much damage after such incidents. The discipline plays a major role in the identification of an individual in any incidents affecting masses like earthquakes, bomb blasts, landslides etc.⁵ Along with damage resistance, the dentition of teeth is morphologically unique on account of which they play as powerful evidence. Another significant aim of odontology is the identification of criminal based upon the analysis of bite marks that are present on the victim's body.⁶ In addition to that odontology is also helpful in the determination of the age, gender, habits, occupation, and race of the offenders or victims.⁷

Dental odontology is not a new subject but it has been used as a vital tool since 66 A.D.⁸ The first case where it was accepted in the court of law was in 1849. Majorly in the past, it was used to identify the dead bodies of historical figures like Jay Chand⁹ and Adolf Hitler.¹⁰ In India, science was also used for finding the dead body of Rajiv Gandhi and other 17 bodies at the crime scene. In Indian history, it was used in providing evidence that led to the sentencing of the accused involved in the Nirbhaya case. It was done based on the bite mark analysis; the forensic dentist was able to link two accused to the crime. As Bite marks of the accused were compared which was left on the victim and the structure of dentition of two accused and the photographs of the bite marks were proved with accuracy which led to their conviction.¹¹ However, Bite mark analysis has helped in solving criminal cases all over the world including India, but there are many shortcomings of the field when used as evidence for conviction which would be dealt with in the paper. As the field has not been given attention

⁴ S Keiser-Nielsen, *Forensic odontology*, 18 INT. DENT. J. 668-83 (1968).

⁵ Kewal Krishan, et al., *Dental Evidence in Forensic Identification – An Overview, Methodology and Present Status*, 9 OPEN DENT. J., 250-256 (2015).

⁶ Vinod Rathod, et al., *Role of forensic dentistry for dental practitioners: A comprehensive study*, 9(2) J. FORENSIC DENT. SCI., 108-109 (2017).

⁷ Mayssa Hachem, et al., *Emerging Applications of Dentistry in Medico-Legal Practice-Forensic Odontology*, 11(2) INT. J. EMERGING TECH., 66-70 (2020).

⁸ BR Chandra Shekar & CV Reddy, *Role of dentist in-person identification*, 20(3) INDIAN J. DENT. RES., 356-360 (2009).

⁹ N Balachander, et al., *Evolution of forensic odontology: An overview*, 7(1) J. PHARM. BIO-ALLIED SCI., 176, 176-180 (2015).

¹⁰ Xavier Riaud, *Dental Identifications of Adolf Hitler and Eva Braun*, 1(1) J. DENT. PROBL. SOLUT., 06-10 (2014).

¹¹ Balachander, *supra* note 8, at 177.

like other aspects of forensic science like fingerprint analysis, DNA testing, trace evidence and development must be done by collaboration, research, resources and other means for improving its accuracy so that the entire justice system could be benefited.

II. BITE MARK ANALYSIS: FORENSIC EVIDENCE

Bite marks are the patterns that are produced by any person's or animal's dentitions which may be composed of teeth alone or a combination of teeth with other parts of the mouth. **MC Donald** has put forward the classification of the bite marks as tongue pressure, tooth pressure and tooth scrape marks.¹² The first case in which bite marks was used as evidence in the court of law was in 1954, *Doyle v. state*¹³ in Texas, where the dentist has used the bite marks of the accused which were left behind by him on the piece of cheese at the crime scene, the evidence was admitted in the U.S court after which it was followed by the judiciary all over the world including India.

Forensic odontology has gained wider acceptance in the field of the criminal justice system because of the uniqueness of the patterns as no two individuals have an identical set of teeth. Bite marks are present as evidence in cases of murder, rape or violence. They are considered as an expression of rage, dominance and animalistic behaviour. Bite marks as evidence are very valuable as through the analysis, the type of physical abuse and age of the accused can be determined. With the increase in cases of rapes, the use of bite marks as evidence is efficiently being used and developed.¹⁴

Bite marks as evidence have already been introduced in the trials. The odontologist's or the dentists compares the marks found at the crime scene with the suspect's dental impression.¹⁵ Bite marks may be present on the body of the victims like on their neck, breasts, lips, cheeks or any other part and it may also be present on the attacker given by the victims for defending themselves. The bite marks can be found on other materials like eatables present at the crime scene. The cast of such bite marks are made or photographs are taken that can be matched with the original teeth of the suspect. Different set up of teeth like crowding of teeth, fractures, malformed teeth, missing teeth, diastema and any other peculiar characteristics of teeth can be helpful in the process of comparison.¹⁶

¹² Saranya Varadarajan & Malathi Narasimhan, *Forensic Odontology: A Brief Review*, 7(2) SRI RAMACHANDRA J. MED., 24-30 (2014).

¹³ B. R. Rothwell, *Bite marks in forensic dentistry: a review of legal, scientific issues*, 126(2) J. AM. DENT. ASSOC., 223-232 (1995).

¹⁴ M. K. Sunil, et al., *Bite Marks: An Indispensable Tool for Forensic Odontological Evidence*, 19(1) MEDICO-LEGAL UPDATE, 42-46 (2019).

¹⁵ Abirami Arthanari, et al., *Bite mark: Is it still valid??*, 4(1) INT. J. FORENSIC ODONTOL., 14-20 (2019).

¹⁶ Krishan, *supra* note 4, at 252.

Various steps that are included in the bite mark investigation are preliminary questions, collection of evidence from the victim, use of demography, visual examination, photography, the test of saliva swab, making impressions, collecting evidence from the suspect, analysis of bite marks, comparing of the impressions of bite marks and drawing the conclusion.¹⁷

Vender Veldon has also suggested the use of image perception technology for the analysis of bite marks and investigation of the crime as the technique provides pseudo three dimensions and additional colouring of images that enhances the accuracy of the whole analysis.¹⁸

III. UNRELIABILITY OF BITE MARK EVIDENCE FOR LEGAL PURPOSES

The status of forensic evidence is changing since the 1990s. The emergence of DNA testing has placed the evidence of bite marks under critical light because of the discovery of wrongful conviction made based on bite mark evidence. Some of the major factors behind the failure are subjective opinions of experts during bite mark analysis, absence of true scientific backing to the claims made by the experts, lack of any accepted uniform standard.¹⁹ There are many areas of controversy that surrounds the evidentiary value of bite marks analysis that has been referred to below.

1. Uniqueness

The uniqueness of human dentition and individuality of bite marks have been accepted beyond reasonable doubt and it has been reiterated and reproduced by many studies but the primary concern lies with the fact that the impression which is made by the bite marks only involves a limited set of teeth and second concern is that there are insufficient details regarding the unique nature of teeth that are used in the identification process.²⁰

According to the study conducted by Sheets et al, in 2011, it was concluded that the dentition of teeth is not unique and the details of the dental metric do not exactly get transferred to the skin.²¹ In a study that was conducted by Holtkotter et al, in 2013, it was found that it was next to impossible to establish any reliable threshold for distinguishing one set of dentition from another. As in recorded bite marks, any change up to plus or minus 1 mm was not distinguished and only when the displacement was up to 5 mm between two specimens,

¹⁷ Kalyani Bhargava, et al., *An Overview of Bitemark Analysis*, 34 J. INDIAN ACAD. FORENSIC MED., 61-66 (2012).

¹⁸ A. Van der Velden, et al., *Bite mark analysis and comparison using image perception technology*, 24(1) J. FORENSIC ODONTOSTOMATOL, 14-17 (2006).

¹⁹ Amanda Lee Myers, *Bites derided as unreliable in court*. LAS VEGAS REVIEW-JOURNAL (Jun. 17, 2013, 08:18 PM), <https://www.reviewjournal.com/news/nation-and-world/bites-derided-as-unreliable-in-court/>.

²⁰ I. A. Pretty & M. D. Turnbull, *Lack of dental uniqueness between two bite mark suspects*, 46(6) J. FORENSIC SCI., 1487-1491 (2001).

²¹ H. David Sheets, et al., *Dental Shape Match Rates in Selected and Orthodontically Treated Populations in New York State: A Two-dimensional Study*, 56(3) J. FORENSIC SCI., 621-626 (2011).

differences were noticed.²² Furthermore, a study conducted by Martin- de- las- Heras et al., concluded that the parameters are insufficient to prove the uniqueness of the bite marks.²³

2. Accuracy and Replicability

A report from NAS has specifically stated that due to the anisotropic property of the skin, the reliability and accuracy of bite marks are impacted. Studies conducted by Sorin Eet al in 2008, have concluded that bite mark distortions arise mainly because of **primary dynamic distortion** which includes associated events distortion, which means that an additional lesion appears after the initial bite mark, number variation, which include multiple or incomplete bites or when the number of lesions is different from one another and the last one is the presence of other characteristics which can include specific, incomplete or mixed distortion.

Secondary distortion can also be a reason for the distortion, they occur after biting and are not directly caused because of tissue modification or biting dynamic, they majorly include time-related distortion, recording distortion and postural distortion. The presence of these types of distortion can not only modify both class and individual characteristics but also makes it very difficult to identify the perpetrator or even confirm that a certain lesion is a bite mark or not.²⁴

The bite marks change over time and can easily be distorted, which can cause biases on the part of forensic experts who can easily be persuaded into matching the teeth of a known suspect to the bite mark.²⁵

3. Conflicting and unpredictable opinions

According to the study conducted in 2013 by Page et al, it was concluded that there was some inconsistency that not only indicate the fundamental problem in the methodology of analyzing bite marks but also lead towards the concerns regarding the accuracy of any conclusion that is drawn after matching dentition to bite marks.²⁶ Another study conducted in 2016 by Reesu and Brown, highlighted the conflicting and inconsistent opinions of the odontologists. The study concluded that there was inconsistency in the opinions of the

²² H. Holtkötter, et al., *Effect of systematic dental shape modification in bite marks*, 228(1-3) FORENSIC SCI. INT., 61-69 (2013).

²³ Stella Martin-de-las-Heras, et al., *A quantitative method for comparing human dentition with tooth marks using three-dimensional technology and geometric morphometric analysis*, 72(5) ACTA. ODONTOL. SCAND., 331-336 (2014).

²⁴ C. G. Sorin H, Cristian, et al., *Bite mark analysis in legal medicine - Literature review*, 16(4) ROM. J. LEG. MED., 289-298 (2008).

²⁵ Erik Eckholm, *Mississippi Death Row Case Faults Bite-Mark Forensics*, N.Y. TIMES (Sept.15, 2014), <https://www.nytimes.com/2014/09/16/us/mississippi-death-row-appeal-highlights-shortcomings-of-bite-mark-identifications.html>.

²⁶ Mark Page, et al., *Expert interpretation of bite mark injuries-a contemporary qualitative study*, 58(3) J. FORENSIC SCI., 664-672 (2013).

odontologists and other members during bite mark analysis over a time interval.²⁷

Minor disagreement among the experts belonging to any field is indeed considered as standard that allows discussion and scope of improvement but in the present case, the disagreements between the odontologists range from minor disagreement to diverging opinions even over the existence of bite marks, which can be realized by looking at the trends of so many cases where prosecution and defense produce forensic dentists having exactly opposite opinions.²⁸ Whenever reputed practitioners put forwards opposite views or strongly disagree over something then not only the reputation of the field gets damaged but the validity of the methods is also questioned. Bite mark evidence can be proved using current data which presently is showing a very disturbing high positive error rate.

4. Race and sex dimorphism

Many studies have found out that different racial groups have got some basic differences in the arch's shape and width, inter canine arch width and other characteristics. Studies also show that there are significant differences in the bite marks of different genders for instance width of the mandibular left canine differs between the genders.²⁹

5. Unavailable standards

In the analysis of bite marks, there are no acceptable points for identification. There have been efforts made by odontologists of different countries to achieve minimum evidentiary value but all have failed and there is no precedent existing to show that minimum features should exist for identification beyond any reasonable doubts.³⁰

6. Wrongful convictions and questionable dental evidence

Dental records can be produced as hard evidence mostly in cases where other reliable evidence are not present for comparison. The evidence sometimes may not be based upon true statistical or scientific validation but on flawed indicative reasoning. Many new methods are being developed all around the world for the comparison and identification of the bite mark but unfortunately, it lacks control on the procedure, process and methodology. The innocent project that was undertaken has proved that many people have been convicted on the basis of the said evidence provided which were then exonerated after the DNA test results which proved otherwise.

²⁷ Gowri Vijay Reesu, Nathan Lee Brown, *Inconsistency in opinions of forensic odontologists when considering bite mark evidence*, 266 FORENSIC SCI. INT., 263-270 (2016).

²⁸ Pretty, *supra* note 19, at 1488.

²⁹ Yuan Chang Xu, *The Validity of Bite Mark Evidence for Legal Purposes*, UNIVERSITY OF WESTERN CAPE, https://etd.uwc.ac.za/bitstream/handle/11394/8193/xu_m_dnt_2021.pdf?sequence=3&isAllowed=y.

³⁰ Reesu, *supra* note 26, at 265.

One such famous case is of **Ray Krone in Arizona**, where Ray was wrongfully convicted based on bite mark analysis. He was convicted for murdering a bartender. After the impression of his teeth matched with the bite mark found on the victim's neck and breast, he came to be known as the 'snaggle tooth killer'. There was no physical evidence found and blood at the crime scene belonged to the victim only. There was no semen found and no DNA testing was done and solely based on bite mark analysis Ray was convicted with a death sentence which was later reduced to life imprisonment. But later in 2002, Ray was released when DNA testing was done and it was proved that Ray cannot be the perpetrator as the blood, saliva that was found on the victim was of a convicted rapist. There were many like cases for instance Willie Jackson of Louisiana, Calvin Washington of Texas, James O'Donnell of New York and others where an innocent person was wrongfully convicted when biting mark analysis was solely relied upon.³¹

IV. BITE MARK ANALYSIS: INDIAN PERSPECTIVE

Bite mark as evidence has been used in many cases like Sheena Murder Case, Nirbhaya gang-rapes case, Paper mill colony case and many others. However, standardization of techniques is missing because of which there is over-dependence on the expertise of forensic dentists and there is a need for transnational research in the said area. There have been many cases all over the world and also in India where innocents have been placed in bars because of the distortions in the analysis, change in the size and shape of the marks because of the alteration in the position of the body or alteration of bite marks due to change in arch configuration of a person over time which is later proved otherwise through DNA results.³²

In India, during the budding stage of any empirical research, the process of institutional oversight should be included and there is a general practice where researchers tend to share laboratory practices for the acknowledgement of errors and further development. In the present case also the forensic odontologists justify their forensic practices on the data and they also show the high error rates in the bite mark analysis as evidence in the court of law and because of these particulars, the court tends to focus less on the level of training or experience and more on the reliability of the existing practices related to bite mark analysis which is based on forensic casework.³³

³¹ *Cases Where DNA Revealed that Bite Mark Analysis Led to Wrongful Arrests and Convictions*, INNOCENCE PROJECT (Jul. 01, 2007), <https://innocenceproject.org/cases-where-dna-revealed-that-bite-mark-analysis-led-to-wrongful-arrests-and-convictions/>.

³² Aman Chowdhry, et al., *Bite Mark Analysis an Indian Perspective - Science Of Failure Or Failure Of Science?*, 7(1) J. INDO PACIFIC ASIA. FORENSIC ODONTOL. 18, 18-23 (2018).

³³ Dr Ambily P & Ashna D, *Faulty Foundations: A Socio-Legal Critique of the Regulation of Forensic Science*

Certain judicial precedents on the usage of scientific evidence in India have shown how courts have failed to condemn the operation of forensic techniques that are unreliable. Referring to the case of Nirbhaya gang rape, Supreme Court has substantially relied on the bite mark evidence that has not only resulted in so many wrongful convictions all over the world but also has been proven to be miserably misleading. In the said case, SC referred only to one-sided academic literature and limited expert testimony for coming to a conclusion that is based upon the doubtful standard of proof which holds that the bite marks are most likely caused by the accused. Usage of reasonable medical certainty by the courts for evaluating bite marks has welcomed criticism for the absence of any accepted measurable scientific criteria for the determination and its application. By providing evidence showing that there is no visible tampering done with the samples does not justify this evidence or provides for a standard of proof beyond any reasonable doubt.³⁴

There are lots of doubts and cross-examination during the analysis of bite marks. The doubts are growing because of the emerging realization that the field as evidence has a limited foundation on science and there are very restricted evidence to support any of the assumptions that are made by the odontologists while comparing the bite marks.³⁵ The rate of error made by forensic dentists are highest more than any forensic technique used for identification but still, it is being practiced and are admissible in the Indian court of law.³⁶

The other major issue in our country is that it lacks awareness among forensic dentists about the significance of maintaining records that pose challenges in the identification of the criminal or cases of a mass disaster. There are many cultural and social reasons on account of which dental professional do not pursue their carrier or research in the said field.³⁷ There have been surveys done on the lawyers, doctors, dentists and police personal who have revealed that there is a lack of awareness among police personal, lawyers and doctors, who are authorized to handle key areas of law enforcement and further steps have to be taken for increasing the involvement of forensic odontology during any accident or criminal investigation.³⁸

Laboratories in India, 7(2) NLUJ L. REV., 191-243 (2021).

³⁴ *Id.*

³⁵ *A Dentist Takes the Stand*, NEWSWEEK, (Aug. 19, 2001, 08:00 PM), <http://www.newsweek.com/dentist-takes-stand-151357>.

³⁶ Jennifer Emily, *Dallas County man freed after serving 25 years for murder over faulty science of bite marks*, THE DALLAS MORNING NEWS, (Oct. 12, 2015), <http://crimeblog.dallasnews.com/2015/10/dallas-countyman-freed-after-serving-25-years-for-murder-over-faulty-science-of-bite-marks.html/>.

³⁷ Varadarajan, *supra* note 11, at 25.

³⁸ Ashwin Narayanan, et al., *Forensic odontology in India key milestones and missed opportunities*, 4(3) EUR. J. FORENSIC SCI., 1-3 (2017).

Forensic odontology is slowly evolving as an integral and vital field of forensic medicine all over the world but it is still facing shortcomings in our country. Reasons behind such infancy can be that there are limited institutions that are offering specialization in India which not only decreases the job opportunities but also decreases the scope of the field. Other reason can be evidence tampering at the crime scene, absence of proper equipment used for analyzing the collected evidence and disregard towards the protocols and rules further causes the downfall of the field from the mainstream.³⁹

V. CONCLUSION AND SUGGESTION

The chain of forensic science is as strong as its weakest link. The importance of bite marks has been realized for providing essential information majorly in rape cases where the accused leave bite marks on the body of their victims. The evidence can act as conclusive proof like fingerprint evidence or DNA evidence. However, there has been no agreement reached among the forensic dentist regarding different aspect of bite mark analysis. The process of analysis lacks standard because of which there are inconsistent opinions and lots of disagreement among the experts. Moreover, many issues are surrounding the evidentiary value of bite mark analysis which further pushes it from the mainstream evidence.

To increase the reliability of the analysis, software which semi-automatically recognizes the dental landmark in pictures and which is not only allows the comparison to be geometrically calculated but also provides excellent reproducibility, should be used for analysis.⁴⁰ The court must not solely rely on the expert testimony as it may be unreliable and invalid but rather an attempt should be taken to develop a valid scientific method.⁴¹ Bite mark analysis has a high error rate because of which bite mark evidence is not sufficient for the conviction of a suspect but DNA testing should be done in a combination for conclusive proof.⁴²

Bite marks evidence should not be shunned because of inaccuracy but new avenues should be developed for exploring different aspects and for improving its accuracy. The introduction of standardization is the need of the hour for the bite mark analysis. More scientific commitment, research, resources are required for the enhancement of the evidentiary value of

³⁹ Iyer, *supra* note 02, at 142.

⁴⁰ Beatriz Ramos, et al., *A new method to geometrically represent bite marks in human skin for comparison with the suspected dentition*, 51(2) AUSTRAL. J. FORENSIC SCI., 220-230 (2019).

⁴¹ Niki Osborne, et al., *Does contextual information bias bite mark comparisons*, 54(4) SCI. JUSTICE, 01-07 (2013).

⁴² Donald E. Shelton, *Criminal Adjudication: The Challenges of Forensic Science Evidence in the Early 21st Century*, UNIVERSITY OF NEVADA, RENO (May 2010), https://privpapers.ssrn.com/sol3/papers.cfm?abstract_id=1610240&rec=1&srcabs=1396657&pos=10.

forensic odontology.⁴³ Collaboration among the judges, police, and forensic dentist experts is very important for solving medico-legal problems.⁴⁴ However, despite all the problems and lacunae in the analysis, result, awareness, there have been instances all over the world including India where forensic odontology has reached its full potential so if all the requirements that could push the field to reach its full potential are met then it can be conclusively said that the branch is going to have a powerful impact in the field of forensic science and criminal law in the future.⁴⁵

⁴³ Chowdhry, *supra*, note 31, at 20.

⁴⁴ Mayssa, *supra* note 32, at 67.

⁴⁵ Ashwin, *supra* note 37, at 02.